under these circumstances fails, and the respiratory efforts cease entirely.

In conjunction with other symptoms, a progressive increase in arterial pressure or a high degree of the same, which has been already reached, or a pressure which exhibits from moment to moment great alterations in level may be taken as a certain indication of the advisability of early operative intervention. In case there are localizable symptoms the site of trepanation is plainly indicated. In case of generalized compression from widespread hemorrhage when there are no localizing indications, the intracranial tension should be relieved by the elevation of a large osteoplastic flap from one hemisphere or the other with a corresponding opening in the dura.

A REVIEW OF SOME OF THE OLDER WRITINGS ON INFANT FEEDING.*

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It was my original intention to embody in this paper a review of the literature relating to maternal nursing, but this idea was abandoned when it was once realized how much there was to consider under substitute feeding. The gist of everything that has been written on maternal nursing can be summed up in a few words: All authorities in the past two centuries have advised mother's milk as preferable to all other forms of infant diet. Prior to this time, however, according to Van Swieten (Paul's translation, 1759), Van Helmont and his school opposed milk in any form.

Substitute Feeding. That much has been written on substitute feeding goes without saying. To do justice to all of it is obviously impossible. My comments, therefore, will be limited chiefly to the writings of the eighteenth century, which were at my disposal, and to the most interesting and important of the works of the first half of the past century, considering only a few of those which have appeared since that time. In doing this I will quote freely from those authors who have written interestingly and instructively.

The methods which have been in favor are three in number: (1) wet-nursing; (2) direct nursing from animals, and (3) the use of artificially prepared foods. All of the older writers are in accord in preferring the first of these—*the wet-nurse*—although this measure has never been considered in any sense comparable to maternal feeding.

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It has been impossible to fix upon the date of the beginning of wet-nursing as a common practice. It is probably safe to assume that it has been indulged in to some extent in all times. It has been a very prevalent custom in the times of which I write, and at certain periods was evidently practised to an extreme degree. John Clarke, writing in London in 1815, says that "The prevalent custom of relegating all children to wet-nursing or dry-nursing has resulted in reducing the supply of wet-nurses and in inducing the wet-nurse to forsake her own child, which invariably dies; therefore, it is hardly a question whether society at large is a gainer or loser by the employment of hired wet-nurses." The moral aspect of the wet-nurse question was evidently more commonly considered formerly than now. "This custom," Clarke goes on to say, "acts as a further detriment to society in that it leads to the neglect of older children, lack of attention to household duties, dissatisfaction with home surroundings, and consequent family differences." He thought that, "On the whole, it would be better perhaps that the children of the wealthy should be brought up artificially where the mother does not suckle them, because they would have every advantage of good nursing, cleanliness, air, and medical treatment, and would, therefore, have a better chance of living than the child of the wet-nurse." He suggested another plan to relieve the difficulty, namely, to have a vigorous wet-nurse feed both her own and the foster-child, the deficiency being made up artificially. John Roberton (London, 1807) refers to the same evils pointed out by Clarke, and suggests much the same remedies. He likewise considered it "the duty of the professional man to make the unfortunate infant deprived of its natural source of feeding every amends in his power."

Dewees (1825) preferred the sucking bottle to "the hireling nurse," unless it be known that the nurse is a person "capable in every respect of fulfilling the important duty of suckling." He pointed out that "the withdrawal of the wet-nurse from her own child and family, in benefiting one part of society, injured another." In order to obviate this, he suggested "that only those women who have lost their own children be employed." He was opposed to their nursing both their own and the foster-child, lest the latter receive too little nourishment.

The following rules laid down by Van Swieten as early as 1759 for the selection of a wet-nurse are most comprehensive and have not been much improved: "She should be examined by a physician, who should determine that she has perfect health; that her skin is natural in color, her eyes lively and animated, her gums firm and of good color, her teeth healthy and clean, her lips red, her habits of body neat and clean, and that no odor exhale from her mouth or nose or any other part. He should also determine that her own child is well nourished." Beside "a prudent monthly nurse should examine every part of her body to exclude suspicious scars or pimples." "She should be from twenty-five to thirty years old, and it is best that she should have borne several children. Her breasts should be firm, distended, elastic, and of medium size." "Large breasts furnish little milk," and, according to Aetius, "in large breasts much swollen with the quantity of milk it becomes corrupted by remaining there, and consequently noxious to the child." "The nipple should be red, firm, and large, but not so large as to interfere with the freedom of the tongue's movements. The milk should run easily and spout a good distance like so many little siphons when the breast is pressed."

Rosen von Rosenstein (1776) indorsed the following lines from St. Marthe's *Pædotrophia* (Tytler's translation) as covering all the points necessary to be considered in the selection of a wet-nurse:

> "Choose one of middle age, nor old nor young,
> Nor plump nor slim her make, but firm and strong.
> Upon her cheek let health refulgent glow
> In vivid colors that good humor show.
> Long be her arms and broad her ample chest,
> Her neck be finely turned and full her breast.
> Let the twin hills be white as mountain snow,
> Their swelling veins with circling juices flow,
> Each in a well-projecting nipple end,
> And milk in copious streams from these descend.
> Remember too the whitish milk you meet
> Of grateful flavor, pleasing taste and sweet
> Is always best; and if it strongly scent
> The air, some latent ill the vessels vent."

The securing of a satisfactory wet-nurse is not a purely modern difficulty. George Armstrong (1783) found that "a good wet-nurse is not always to be had, especially in or near great cities, where so many of them are given to drinking and other vices, and the worst of them will fall upon means of securing a good character." He found that the tendency on the part of the wealthy to indulge wet-nurses in all directions, especially in the giving of large salaries, "led to the ruination of many, making them as a class very unreliable." Clarke and many others refer to this, and several of the writers in the early part of the nineteenth century advised "that nurses owing to their loose morals be carefully guarded and deprived of all care of the infant, seeing it only at the time of nursing."

Direct Nursing from Animals. The second method of substitute feeding is one which has never come into common usage for several reasons: First, it has many repellent features; second, the milk of animals is not adapted to the digestive powers of infants; third, the method is not practicable. The goat, sheep, ass, and cow, the animals that have been in favor for this purpose, are not convenient household pets, especially in our cities. Several of the earlier writers refer to the custom, and one or two practised it. Chambon (1799), for instance, preferred "suckling infants directly from a goat, a sheep, or an ass, to any form of substitute feeding." "The first," he found "very easy to manage, as goats proved susceptible to an attachment for the children which they nursed." He says "they come when full into the house and place themselves in a comfortable position to give the udder to the nursling."

At a much later period (1840) Andrew Combe quotes Dr. Von Ammon as advising that at the fifth month "the child should drain his food directly from the cow, and thus receive it in its natural state and at its natural temperature," and in support of his recommendation he says "infants fed in this way in the country thrive far better than those fed on cow's milk in towns."

Even at the present day in some parts of France infants are nursed directly from cows, and sometimes with good results. It is very probable that in Spain and Italy, where goats are commonly used as a source of milk supply, direct nursing is indulged in. Dr. Rotch (*Pediatrics*) refers to having observed a family of eight children "all of whom were nursed by the family cow, and were all healthy and strong."

It has usually been customary, however, when wet-nursing was impossible, to resort to some one of the various methods of artificial feeding.

ARTIFICIAL FEEDING. The foods which have been in most common use for this purpose are the milk of the ass, the goat, and the cow, broths made from the flesh of animals, and an innumerable variety of starch-containing and mucilaginous decoctions. The milk of the ass and the goat is still extensively used in some countries, and at one time was pretty generally preferred to that of the cow. It was early recognized, however, that the difficulty in securing the milk of these animals rendered this source of food impracticable. For this reason, the milk of the cow has been much more generally used. The milk of the ass and the goat, owing to its greater similarity to human milk, was usually given undiluted. The milk of the cow, on the other hand, has been given in a diluted form for many years. Judson and Gittings, in their recent work on *The Artificial Feeding of Infants* (Philadelphia, 1902), state that "the necessity of dilution to adapt cow's milk to the infant's powers of digestion was recognized as far back as the middle of the eighteenth century." They quote from the work of J. P. Frank, *On the Raising of Healthy Infants* (1749), to the effect that "Van Swieten, Loseke, and Cosner were the first to recommend diluted cow's milk for infant feeding; they advised to dilute from two to five times with water."

I have not had access to the writings of Loseke and Cosner to confirm Frank's observation respecting their methods, but in Paul's translation of the *Aphorisms of Boerhaave*, with comments by Van Swieten, I find no reference to diluted cow's milk. It would not be surprising, however, to find that Van Swieten made some such recommendation, since his writings show evidence of an advanced and thoughtful mind. In some works of earlier date than this—the work of Walter Harris (1742) for instance—one fails to find any reference to the subject. Some of them do not even mention cow's milk, advising instead the milk of the ass or goat or some one of the various paps or panadas. Van Swieten quotes Von Helmont—who wrote in the very early part of the eighteenth century—as condemning the use of milk of all kinds, his objection being that "milk turns sour in the stomach." He preferred "a pap made with beer," which Van Swieten considered "a very singular preference which he did not satisfactorily explain."

The earliest reference I could find to the use of diluted cow's milk was in Sparrman's translation of Nicholas Rosen von Rosenstein's *Diseases of Children and Their Remedies*, published in 1776. He advised the use of "cow's or goat's milk—unboiled—diluted with water and sweetened with a little sugar." He sometimes used barley-water as a diluent, and where constipation existed he added a little thin filtered oatmeal gruel in which there had been dissolved a little clarified honey. He objected to the use of paps as "too gluey, tenacious and slimy and liable to produce obstructions in the mesentery, hardness of the stomach, acidities, wind, etc., by means of which we lose at least the one-half of our children." At the age of six months he gave whole milk containing rye biscuit which had been previously soaked in water. He fails to specify the amount of his dilution.

Underwood (1789) used somewhat similar but equally indefinite dilutions. He preferred either "water in which a piece of roll and some upper crust had been boiled, or hartshorn shavings boiled in water to the consistence that veal broth acquired when cold" as his diluent. To this mixture he added a little Lisbon or loaf-sugar. He, like Rosen von Rosenstein, was opposed to the use of paps and panadas in early infancy, but toward the end of the first year he gave some bread panada with broth.

George Armstrong, writing a few years earlier (1783), who considered himself well qualified to advise upon the subject of dry-nursing, in "that he had had some experience of it in his own family," directed as an adjuvant to maternal nursing "crumb of stale bread or, preferably, roll boiled in soft water to the consistency of pap, sweetened with a little soft or Lisbon sugar." For hand-fed infants, however, he directed that "cow's milk be added to their victuals as often as possible, and now and then some of it alone to drink." After weaning he used, in addition to other foods, "water in which the upper crust of bread had been boiled, mixed with an equal quantity of new or boiled milk." This is the first instance in which the proportions of milk and water are indicated. It is probably safe to assume that the cow's milk used by this author as an adjuvant to maternal nursing, although not so stated, was a diluted milk. It is not probable that he would reserve the diluted milk for the latter months of the first year.

Moss (1794) gave much more definite directions for the modification of milk than did any of his predecessors. His ideas were advanced, instructive, and clearly expressed. He wrote thus: "Owing to trouble in the mother and inability to get a wet-nurse, it is sometimes necessary to secure some artificial food, for which purpose it will be advisable and proper to make choice of such food as appears to approach the nearest in quality to mother's milk. Ass's milk comes nearest to the human of any we are acquainted with, and, therefore, when it can be had it is very desirable and proper. Cow's milk being the only milk in general use, must be had recourse to, and will answer the purpose very well; but as it is a good bit thicker than breast milk, it will be necessary to reduce it to the proper consistence by diluting it with water. If the milk be good, about one part milk and two parts water will do very well to give at first. It is always best to err on the side of too great dilution." This mixture, which represents the same dilution as that advocated by the elder Meigs in 1850, was indirectly dependent upon some chemical analyses of cow's and human milk made by one Hoffman. This experimenter found that the inspissated residue obtained by the evaporation of cow's and human milk was as 13 to 8. On this basis Moss attempted the production of an artificial human milk by the dilution of cow's milk with water in the same proportion. This mixture seeming to the sight and taste so much stronger than human milk, he gradually increased the dilution until he obtained a mixture "possessing as nearly as possible the physical properties of human milk." His 1 in 3 mixture was the result; but even this, he says, "seemed a little less dilute than human milk." He did not consider the addition of sugar necessary unless the infant had been used to sweetened food. In preparing this food he used the freshest milk possible, preferring that just from the cow. He mixed at one time only enough to serve for a single feeding. This mixture he found could be advantageously substituted for mother's milk, and that "in general it agreed with infants much better than the other kinds of foods with which they were usually fed."

He was opposed to boiling, believing that this "made milk harder of digestion and binding; warming without boiling also did this, but to a less degree." In addition to milk he gave "chicken or veal tea to children who were dry-nursed," preferring the latter for the following very amusing reason: "It seems highly probable that the juices of the young of those animals that feed upon milk are more likely to prove acceptable to the stomach of a child than those of the animals, as the cow, that may have formerly fed upon milk. The juices of the young sucking animals must be considered in a state approaching nearer to milk than those of other animals that do not derive their support from milk. Their juices, as partially abstracted by slight boiling, appear to be no other than milk somewhat more elaborated, assimilated, and animalized."

Struve (1801) used an equal quantity of milk and water in the preparation of a pap which he recommended. He considered the most wholesome beverage for children during dentition to be "equal parts of milk and water;" but when dry-nursing was first begun he advised "two-thirds of water to one of milk." "This should not be boiled, but heated to the boiling-point." He also highly recommended sweet whey prepared according to the following formula (Hufeland): "A slice of calf's stomach which had been prepared in vinegar and dried, should be soaked for two hours in a cup of water and then poured with the water into a pot of unboiled milk, from which the cream has been carefully separated. This is gradually heated, but not boiled. After a quarter of an hour the cheesy portion separates and the whey is left below. This should be poured off from the curds." He found that in the first months infants could live upon this alone.

Chambon (1799) used a mixture similar to that prescribed by Struve, but he preferred a preparation of grated crust of bread boiled in cream.

Heberden (1807) considered the object aimed at in artificial feeding to be the preparation of a mixture that resembles the mother's milk as nearly as possible. To accomplish this he used "ass's milk or milk and water with a little sugar of milk mixed with a little gruel, barley water, thin panada, or rice water, passed through a lawn sieve to insure their being smooth."

Roberton (1807), writing in the same year, found cow's milk objectionable at an early age on account of the large proportion of its curd; but cream diluted with five or six parts of water he used advantageously. He gave the preference, however, to "biscuit powder or small crackers boiled in water to a thin gruel, carefully beaten through a sieve and sweetened with fine sugar."

James Hamilton (1809) preferred "ass's milk or cow's milk mixed with a little water and sugar to which a small portion of milk biscuit may be added." He also used "arrowroot or patent sago mixed with water and milk, and to a less degree pap and panada." He added weak beef or chicken tea occasionally after the third month.

John Clarke, London (1815), whose work is very instructive and interesting, advised an "entirely fluid diet" that should be taken until the teeth appear. For this purpose he used ass's milk or "cow's milk pre-

-viously skimmed, with two-thirds or three-fourths of its measure of gruel made from pearl barley, grits, rice, or arrowroot." "Where so mixed," he says, "the curd does not become so hard in the stomach as when diluted with water alone." As the child grew older the proportion of milk was gradually increased. Where this mixture disagreed he gave weak mutton, chicken, or beef broth, "clear and free from fat, mixed with an equal measure of any of the mucilaginous or farinaceous decoctions." After the appearance of the teeth he gave solid farinaceous substances boiled in water, beaten through a sieve and mixed with a small quantity of milk.

In instances in which the above preparations disagreed he sometimes obtained good results from a mixture of the farinaceous decoctions with a little cream.

Judson and Gittings, on the basis of this last suggestion, refer to Clarke as "one of the first to advocate the employment of cream diluted with starchy decoctions." As has been previously pointed out, Chambon, in 1799, recommended as useful a mixture composed of grated crust of bread dissolved in cream. His purpose in using this preparation—its "slight susceptibility to acid fermentation in the stomach"—was not the same as Clarke's. The latter added the starches for the same reason that they are often used to-day, namely, to break up the thicker curd of cow's milk. When so mixed, he says "the curd does not become as hard in the stomach as when diluted in water alone." So while their practices were much the same, and their results probably akin, the principles on which these results were based were entirely apart.

Dewees (1825), whose work seems to have been closely followed by other writers for many years, advised a mixture composed of milk two-thirds, water one-third, and "a small quantity of loaf-sugar." He used pure home milk as fresh as possible and from one cow. He gave very explicit directions regarding the preparation and care of his milk mixture. He advised that each feeding be prepared separately, that it be heated by the addition of hot water or on the sand-bath, and that the milk be kept in a cool place, and when in the least acid, rejected. Milk should never be boiled. In hot weather "it is true the tendency to decomposition is diminished by boiling; but this can be as satisfactorily accomplished by putting it, closely covered, over a hot fire and bringing it to the boiling-point; so soon as this is reached it should be removed and cooled as speedily as possible." "This plan prevents in a great degree the formation of the strong pellicle on the top, which deprives the milk of a portion of one of its most valuable parts."

James Kennedy (Glasgow, 1825), writing in Scotland in the same year, advocated what is, as far as I can ascertain, the first cream and whey mixture. He says "such forms of prepared aliment are preferable, as they consist of milky and farinaceous substances agreeably sweetened. Of all these, recent cream of cow's milk diluted with whey (made from rennet) and arrowroot appear, from experience, to be the most congenial." He did not specify the proportions of the different ingredients used.

During the fourth decade of the nineteenth century little new was added to the methods of infant feeding. Practically all of the writers, as has been intimated, adopted the recommendations of Dewees. Marshall Hall (1831) preferred "pure beef tea without spice and with or without sago" to any of the milk foods. Eberle (1833) advised "farinaceous decoctions mixed with a small portion of cream" where no other form of milk could be given, and Combe (1840) advocated "fresh cow's milk, tepid and diluted with half or more of water and slightly sweetened." Cow's milk given in this way he considered "decidedly preferable to gruel, panada, arrowroot, chicken tea, or any other preparation less analogous to the natural food of the child." When children were artificially fed from birth the first food he suggested was composed of "two-thirds of pure fresh water added to one-third cow's milk. Goat's or ass's milk does not require more than an equal quantity of water." "After a week or two the water may be reduced to one-half, and later to one-third, at which proportion it should be continued for four or five months." This dilution, it is noted, is greater than that recommended by Dewees and his successors, and the attempt is here made to gradually increase the strength of the mixture as the age advances. Combe urged the utmost cleanliness regarding the care of dairy implements, and considered the excellence of dairy products in "Holland and other places" as "due almost entirely to this single cause."

It was not until the elder Meigs, in the second edition of his work on *The Diseases of Children* (1853), published his revolutionizing formula that the subject of infant feeding received a new and much-needed impetus.

Meigs was the first writer to appreciate the necessity of adding cream in order to obtain a proper fat percentage in his mixture. The mixture known for so many years by his name was prepared as follows: "A scruple of gelatin was soaked for a short time in eight tablespoonfuls of cold water and then boiled until it was dissolved, for about ten or fifteen minutes. To this was added, with constant strirring and just at the termination of the boiling, one-half pint of milk and arrowroot, the latter being previously mixed into a paste with a little cold water. After the addition of the milk or arrowroot and just before the removal from the fire, eight tablespoonfuls of cream were poured in and a moderate quantity of loaf-sugar added." The proportions of milk, cream, and arrowroot were made to depend upon the age and digestive powers of the infant. For a healthy infant of a month he gave from three to four ounces of milk, one-half to one ounce of cream and a teaspoonful of arrowroot, to one-half pint of water. For older children the quantity of milk and cream was gradually increased to one-half or two-thirds milk and from one to two ounces of cream; the gelatin and arrowroot remaining the same.

Judson and Gittings state that in the seventies Meigs advised a mixture of equal parts of milk, cream, lime water, and arrowroot water, sweetened with a little sugar. This formula, which they mark as "the fountain-head" of all the later advances in milk modification, is not mentioned in any of the several editions of his work, and must have been obtained from some other source. It would really seem more fitting to mark the earliest formula of Meigs as "the fountain-head," since it was success in the use of this formula that led to the preparation of a monograph entitled *Food for Babies*, by William Henry Cumming, M.D., of Williamstown, Mass., and published in New York in 1859. In the preface to his work he eulogizes the writings of the elder Meigs, and points out that it was the success he met with in the use of the Meigs formula that stimulated him to a careful study of the subject of infant feeding, the result of which he so well presents in the work under discussion. This author approaches more nearly to a scientific modification of cow's milk than anyone who wrote prior to his time or for many years after. He says: "The milk that is adapted to a new-born calf is not suitable to an infant. It must be modified, or else it will do harm rather than good. Everyone knows that an infant cannot bear pure cow's milk, and everyone adds more or less water to weaken it. There is too much casein in cow's milk, and the infant cannot digest it. There is almost three times as much as in human milk, as seen by the following tables:

"In 1000 parts of cow's milk there are of	Butter	38.59	parts.
	Casein	40.75	"
	Sugar	53.97	"
	Water	866.69	"
"In 1000 parts of human milk there are of	Butter	20.76	parts.
	Casein	14.34	"
	Sugar	75.02	"
	Water	889.88	"

"Therefore, to reduce the casein of cow's milk to the proportion found in human milk, we must add one and four-fifth times, or nearly twice, as much water. Milk thus diluted will not be likely to disagree with the child's digestion; but after a time one will find that the child is not thriving on this diet, for the reason that the proportion of butter has been diminished with that of the casein from 38.59 to 13.58—just about two-thirds of the proportion existing in human milk (20.76)—a proportion which is far less than the infant demands.

"To those at all familiar with the elements of arithmetic it will be evident from comparing the relative proportions of the ingredients that dilution of ordinary cow's milk will never enable us to imitate the composition of human milk. It is possible, however, to obtain a milk having this composition in two ways: First, by taking the upper third of cow's milk that has stood for four or five hours, which has the following composition: butter, 54; casein, 38; sugar, 52; water, 856. By adding to this sugar 142, and water 1458, and dividing by 2.6 to reduce it to thousandths, we obtain a mixture having practically the composition of human milk. Another and in warm weather a better way is by taking milk from the latter half of that given by the cow. The first part contains very little butter, the last part is very rich—about 56 parts in 1000 in butter. This milk when diluted with one and one-half parts of water and properly sweetened resembles ordinary human milk."

That he appreciated the necessity of varying dilutions for varying ages is evident from what follows: "Mother's milk for the first two weeks after birth has a peculiar composition. From its first appearance it gradually changes until it becomes ordinary milk. Our mode of feeding involves the imitation of these several qualities of the milk. We call our substitute 'artificial human milk.'" The method of obtaining a milk to meet these various requirements is indicated in the following table, which shows the quantities of milk, sugar of milk, and water required for the various age periods. His formulæ are expressed in the proportions of the different ingredients contained in 1000 parts of milk. Thus 1000 parts of the milk taken from the upper third of cow's milk which has stood for four or five hours, as previously stated, contains 54 parts of fat, 38 of proteids, 52 of sugar, and 856 of water.

In order to obtain the proper proportions of the ingredients for the different age periods, he adds to this top milk, which is especially rich in fats, certain amounts of water and milk sugar. Being curious to know exactly what this table represented I have worked it out, and in so doing obtained some very interesting results.

He prescribed a mixture of the following strength:

	F.	P.	S.
For the age of 1 month	1.5	1.1	7.4
" " 2 months	1.8	1.3	7.4
" " 3 "	2.0	1.4	7.4
" " 4 "	2.3	1.6	7.4
" " 5 "	2.6	1.8	7.4
" " 6 "	2.7	1.9	7.4
" " 7 " and 8 months . .	2.9	2.0	7.4
" " 9 " to 10 " . .	3.0	2.1	7.4
" " 11 " to 13 " . .	3.1	2.2	7.4
" " 14 " to 17 " . .	3.3	2.4	7.4
" " 18 "	3.5	2.4	7.4

For children under one month he made his mixtures by diluting the upper eighth of a bottle which had stood for four or five hours, making his dilutions much greater.

It is to be assumed, since Cumming does not state that the analyses which he used are borrowed from others, and since they do not quite agree with any of those made prior to his time, that he made his own. In so doing he has been in error in considering the top milk he used—the upper third of milk which has stood for four or five hours—to contain but 5 per cent. of fat. According to Chapin's table, this milk should contain about 10 per cent. of fat, which would, of course, practically double the fat percentages indicated in his table. Had he restricted himself in the preparation of his mixtures to the milk obtained in the latter half of the milking, assuming as he does that this was a 5 per cent. milk, he would probably have more nearly obtained the results he thought he had obtained by the other method.

Cumming fully recognized the limitations of these formulæ. Thus he says "this schedule is arranged to suit the wants of vigorous children, but in using it great care and skill are needed. Regard must be had not to the mere age, but to the condition of the child. One child goes on prosperously to the age of six months; he is in every sense six months old. The dilution directed for that age will suit him exactly. Another during his third or fourth month is sick and feeble. On learning these facts and observing his condition we should say: this child was born, it is true, six months ago, but his time has been ill spent; he has not made the usual progress; we must reckon him as only four or five months old. To such an one we give the milk suited to the seeming age. It is indeed always safer to begin with milk somewhat more diluted than the child's age indicates and to increase its strength as the case will permit. It is less hurtful that the food should be insufficient than that it should be indigestible. . . . If a child using this milk becomes sick it is well to diminish at once the strength of his food to that of a child three or four or sometimes (in severe cases) six months younger."

He also appreciated the value of increasing the percentage of fat where there existed a tendency to constipation; thus he says: "It will sometimes happen that, while using milk prepared according to the foregoing directions, constipation may occur. An addition of butter to the milk will here be useful." He follows this by an explanation of the manner in which the fat percentages may be increased.

He evidently met with the same obstacle in applying this plan of feeding that often confronts us in our attempts to feed infants from the laboratory, namely, the cost. He says "this prepared method of artificial lactation involves much care and expense. The excellence of our plan is not that it costs nothing, but that it will repay the parent for all the labor and money expended. How much money is yearly expended in securing medical aid for children who need not medicine but food?"

These quotations from this very interesting work are sufficient to make it evident that a successful effort at definite percentage feeding was made at an earlier period than we have hitherto thought. It is difficult to determine how extensively this booklet has been read, but since one finds no reference to it in the text-books on pediatrics, it is probable that this careful, observing, and original author made a valuable contribution to the elucidation of an obscure subject without even obtaining an audience for his opinions.

The development of percentage feeding beyond this point, including the works of the younger Meigs, of Rotch, and others, is so familiar to all of us that it is unnecessary to consider it in this communication.

It is sufficient to say of the *starchy* and *mucilaginous preparations* and the various *animal broths* and *teas*, that they have been prominent constituents of the infant's dietary in the period covered by the literature which has been reviewed and probably for many years prior to that time. Many of the older writers preferred them to milk in any form, while the majority of those who preferred milk permitted the use of these substances as additional foods. Still another class prepared their paps, panadas, etc., with milk instead of water, thus combining the two methods.

The so-called pap or panada—the terms are sometimes used synonymously and sometimes to describe different preparations—have been very variable in composition. Des Essartz (1760) gave the following directions for pap: "Put in a copper or iron kettle (preferably the latter) some fine wheat flour. Cover this with cold cow's milk added little by little. When thoroughly mixed cook until thick." The degree of thickness should vary with the age of the infant.

Armstrong (1783), on the other hand, used "the crumb of stale bread, roll, or biscuit boiled in soft water to a proper consistency sweetened to taste like new milk." This latter method probably conforms more nearly to that adopted by the generality of writers.

Broths have been almost universally sanctioned as a part of the diet of the latter months of the first year. Only one writer—Marshall Hall—seems to have placed them before all other food preparations.

Before bringing this essay to a close, it seems desirable to consider the implements which have been used in the administration of artificial foods. They are the boat, the spoon, the sucking horn or bottle, and the pot of Dr. Hugh Smith. But one reference is made to the last mentioned, and that is by Underwood (1789). "It is formed," he says, "in the shape of an Argyle or gravy pot, with a long spout rising from the bottom and pierced only with a few small holes at the end, which is to be covered with a piece of vellum or parchment which, being left loose a little way over the spout, is as soft and pleasant to many infants as the breast. The boat, spoon, and horn are in no way comparable to it." He advised strict cleanliness in its use.

The spoon is referred to but not recommended by Des Essartz (1760). He graphically describes and bitterly denounces the filthy methods resorted to by nurses in the use of this instrument. He says: "After putting the pap in the spoon they carry it to their mouths, cool it off, return it to the spoon and then give it to the infant." "Some nurses, not wishing to use the spoon, place their index fingers in the food, which after cooling, they permit the infant to suck."

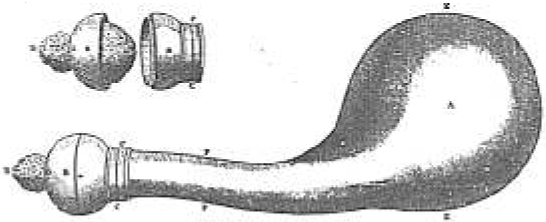
I have endeavored to fix upon the date of introduction of the nursing horn or nipple, but without success. Among the writers I have consulted, Rosen von Rosenstein (1776) was the first to recommend the sucking horn. From his reference to it, one would infer that it had not been much used outside of Russia prior to that time. He writes thus: "If we cannot procure a nurse and the mother cannot suckle her child, then we must accustom the infant to suck by means of a little instrument called a sucking bottle, which is universally used in eastern Bothnia with great advantage; but this machine ought always to be kept clean. It is to be made of a horn, the smaller end of which may be fastened to a tanned skin of a cow's teat, or if this is not to be procured we may use any other thin skin pierced with many small holes."

Armstrong (1783) describes this instrument in the following manner: "The horn made use of for suckling is a small polished cow's horn which will hold about a gill and a half; the small end is perforated and has a notch around it to which are fastened two small bits of parchment, shaped like the tip of a finger of a glove and sewed together in such a manner that the food poured into the horn can be sucked through between the stitches." This description marks a slight improvement in the manner of preparation of the horn and suggests a new substance for the artificial nipple.

In 1794 Moss described "a machine made of horn or *tin* so contrived that the child sucked his food from it as from a breast."

In 1786 Baldini described what was probably the first glass nursing bottle, a sketch of which is submitted for inspection. (See illustration.) He says of it: "This bottle, made of glass or crystal, is surmounted by a hollow metal knob which is gilded so that it will neither rust nor collect verdigris. This knob is divided in its centre into equal portions which screw together. The distal portion is perforated by a small aperture, through which a portion of a sponge placed in the hollow part protrudes. The protruding portion of the sponge represents the portion from which the child sucks."

For the poorer classes he advised "an ordinary bottle capped with a piece of chamois." The chamois was "open at the end and surrounded a piece of sponge which extended into the neck of the bottle and protruded through the opening described. He advised that this apparatus "be washed many times each day in tepid water."



The first glass feeding bottle.

Chambon (1799) recommended a feeding bottle, evidently referring to a glass bottle, "the orifice of which was closed with a linen rag or piece of sponge to prevent the milk from running too rapidly." He says, "I will not describe the methods which have been published to simulate the breast nipple," from which one would infer that there had been many. He, like his predecessors, insists upon scrupulous cleanliness in the care of this instrument, "as otherwise it contracts a disagreeable taste, disgusts the children, occasions vomiting, and infects the milk, causing it to change rapidly in the stomach."

After this date both the horn and bottle were recommended, the horn rather more than the bottle, until Dewees, in 1825, recommended "a flat oblong nursing bottle covered with a properly prepared cow's teat." He insists that "much care be given to preserving it sweet. One should never put a second supply of milk or food upon the remains of a former. The bottle should be emptied after each nursing and immediately cleaned with hot water; it should then be thrown into and kept in a basin of cold water in which there is a little soda dissolved, and, before being used, well rinsed with clean cold water."

He prefers the heifer's teat to any other form of nipple, and urgently recommends that it be prepared "by those who understand this art." It must not be too large or permit too rapid a flow of the food. It should always have a piece of sponge in it to control the flow. Both the teat and the sponge should be well washed after each feeding and be kept in whiskey and water. Clean thread should be used each time the teat is tied on." He also refers to a tube which was in use at this time, and condemns it, owing to the difficulty of keeping it clean.

In 1833 Dendy recommended as a nipple "washed leather or the teat of a young heifer, in which a small piece of sponge is placed in imitation of the pores of the nipple, to prevent too rapid a flow of milk. The first is more easily kept clean, but the latter more acceptable to the infant; indeed, more eligible, as it brings the necessity of constant cleaning." He advised keeping it between feedings in rose or distilled water to which a few drops of spirit of wine had been added.

Combe (1840) advised either washed leather, chamois, or a few folds of fine, soft linen, pierced with a small hole for the mouth of the bottle. "Sometimes a small piece of sponge covered with a rag, or the *artificial cork nipple recommended by Dr. Bull*, may be preferred. Whatever material is used, great care must be taken not to have the holes too large." This author quotes Erdman as saying that "the peasantry in Russia, even at this late date, are using, instead of a nursing bottle, a cow's horn with a small hole at the point, over which a cow's teat is tied. The teat is placed in the child's mouth, the milk poured in at the larger end of the horn and the child left to suck at pleasure." And Van Ammon says that "among these people the horn is not cleaned and frequently the teat passes into a state of putrefaction."

Churchill (1850) used chamois or cow's teat for a nipple, preferring the latter, and also described a thin elastic cork nipple invented by M. Dardo, of Paris, and *one of ivory* from which the earthy matter had been removed and which was flexible and elastic. He did not consider them as satisfactory as the calf's teat, "being far too short."

The first reference I have been able to find to a rubber nipple appears in the work of Tanner, published in Philadelphia (1861). He advises a nipple formed of *vulcanized India rubber*. S. Barker (London, 1864) recommended a nipple made of ivory, cork, *India rubber* or wash leather.

The high mortality in earlier times among the artificially fed (six in eight, according to Dr. Merriman, quoted by Dendy), in the light of what has gone before, would seem to have been not so much dependent upon defective formulæ as upon the poor methods of administration and probable lack of care in collecting and preserving the milk.

NOTE.—Since writing the above I have discovered that the first communication of William Henry Cumming, M.D., on the subject of diet in early life appeared in THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES for July, 1858, N. S., vol. xxxvi., p. 25, under the title, "On Natural and Artificial Lactation." This article formed the basis of his monograph. It demonstrates clearly that the chemical analyses quoted from the monograph were the results of his own work.

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A CASE OF GANGRENE OF THE LUNG CURED BY OPERATION.[*]

By David Riesman, M.D., A. C. Wood, M.D.,

AND

G. E. Pfahler, M.D.,

OF PHILADELPHIA.

The history of the case is as follows:

I. P., a negro, aged sixty-three years, born in Delaware, was admitted to my wards in the Philadelphia Hospital on July 22, 1902. His mental condition was such that a complete history was not obtainable, but it was ascertained that his family history was good and that his own health had always been satisfactory.

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[*] Read before the College of Physicians of Philadelphia, December 3, 1902.